

# A Survey of Fungal Diversity in Northeast Ohio<sup>1</sup>

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**ABSTRACT.** Threats to our natural areas come from several sources; this problem is all too familiar in northeast Ohio. One of the goals of the Geauga County Park District is to protect high quality natural areas from rapidly encroaching development. One measure of an ecosystem's importance, as well as overall health, is in the biodiversity present. Furthermore, once the species diversity is assessed, this can be used to monitor the well-being of the ecosystem into the future. Currently, a paucity of information exists on the diversity of higher fungi in northern Ohio. The purpose of this two-year investigation was to inventory species of macrofungi present within The West Woods Park (Gauga Co., OH) and to evaluate overall diversity among different taxonomic groups of fungi present. Fruit bodies of Basidiomycetous and Ascomycetous fungi were collected weekly throughout the 2000 and 2001 growing seasons, identified using taxonomic keys, and photographed. At least 134 species from 30 families of Basidiomycetous fungi and at least 19 species from 11 families of Ascomycetous fungi were positively identified during this study. The results of this study were more extensive than from those of any previous survey in northeast Ohio. These findings point out the importance of The West Woods ecosystem to biodiversity of fungi in particular, possibly to overall biodiversity in general, and as an invaluable preserve for the northeast Ohio region.

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## INTRODUCTION

Fungi are among the most diverse groups of living organisms on earth, though inadequately studied worldwide (Hawksworth 1991; Cannon 1997; Rossman and Farr 1997; Guzman 1998). This is especially true in Ohio. The paucity of information for fungi is due to a number of reasons, including the fact that complete surveys of fungal diversity at the species level—even for a small geographic region—can be an exhaustive task. For identification of “higher” (that is, more highly evolved) fungi, the fruit body (also referred to herein as “mushroom”) is needed for examination. Mushrooms of many or even most species of fungi can be small and inconspicuous, ephemerally produced in good years—absent altogether during suboptimal years, and identification difficult for many closely related species. Furthermore, fungi have received scant attention simply because of a lack of awareness by the layperson—as well as the biologist—of their significance to evolution, ecosystem function, and human progress (Hawksworth 1991). As has been the case elsewhere, northern Ohio has been the site for few surveys of higher fungal diversity (Fink 1915; Fink and Richards 1915; Corrington 1921; Cibula 1974).

Threats to our natural areas come from several sources, including urban development, pollution, extraction of natural resources (logging, mining, and so forth), and recreational usage. Many of these problems are all too familiar to northeast Ohio. In a recent report by the Geauga County (Ohio) Park District (2000), it was noted that in the past two years alone, development has outpaced preservation of land 10 to 1 in Geauga County. At the current rate of development, it is estimated that all of Geauga County will be developed within 50 years. As a result, there has arisen a recent

need for biodiversity assessment to evaluate the fates of ever-decreasing natural habitats (Hawksworth 1991; National Research Council 1993; Cannon 1997; Rossman and Farr 1997).

One of the goals of the Geauga County Park District is to protect high quality natural areas from rapidly encroaching development (Gauga Park District 2000). The “quality” of the Park District’s natural areas is judged every day by visitors and by participants of recreational and educational programs to the park system. But the quality of those same natural areas also can be gauged scientifically. One measure of an ecosystem’s importance is its overall biodiversity—that is, the richness of species living within the habitat (Lovejoy 1997; Wilson 1997). Furthermore, once the species diversity is assessed, this database can be used as a reference to monitor the overall health of the ecosystem into the future. The purpose of this two-year investigation was to inventory species of macrofungi (primarily mushrooms) present within The West Woods Park (Gauga Co., OH) and to evaluate overall diversity among different taxonomic groups of fungi present.

## MATERIALS AND METHODS

The techniques used in this study were similar to those previously used in published surveys of fungal diversity (Cibula 1974). The site chosen for the study was The West Woods, a 900-acre park located along State Route 87, east of State Route 306, near Newbury in western Geauga County, OH. Much of the biome is mixed mesophytic woodland; American beech (*Fagus grandifolia*), sugar and red maple (*Acer saccharum* and *A. rubrum*, respectively), and northern red oak (*Quercus rubra*) tree species dominate. There are areas of swamp-land and meadowland, as well as sandstone (Sharon conglomerate) outcrops.

All surveys and collections were made weekly from

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1 April – 1 December 2000 and 1 April – 1 November 2001. Macroscopic fungi (primarily Basidiomycetes and Ascomycetes [= “mushrooms”]) were identified in the field (when possible) and photographed. For positive identification, taxonomic keys were used (Lincoff 1984; Arora 1986; Phillips 1991; Smith and Weber 1996; Bessette and others 1997). Spore prints and/or cultures were taken and maintained in the laboratory, when necessary.

## RESULTS

While a larger portion of North America experienced extreme low levels of rainfall during much of the year 2000, northeast Ohio saw unusually cool, wet weather. This may have contributed to the abundance of mushrooms (in both numbers and species diversity) seen in the region throughout the year. Year 2001 was just the opposite. The summer of 2001 proved to be one of the hottest and driest ever for northeastern Ohio; July 2001 was the driest all-time with little more than 0.5 in of rainfall (National Climatic Data Center 2001). The disparate environmental conditions that can occur from year to year point out the importance of multi-year studies when attempting to make statements about fungal biodiversity.

At least 134 species from 30 families of Basidiomycetous fungi and at least 19 species from 11 families of Ascomycetous fungi were positively identified during this study (Table 1). Included in the list of identified taxa present in The West Woods are several highly prized edible species, as well as several species known to be highly toxic (for example, *Amanita* spp. and *Galerina* spp.).

## DISCUSSION

Monitoring the biodiversity of the environment, as well as threats to the environment, has come to the forefront of the public's concern of late. We now are aware that the simple fragmentation, as well as outright destruction, of our natural areas is leading to an ever-increasing decline in biodiversity worldwide (Kishbaugh and Yocam 2000), including fungal species (Bunyard and others 1996). Knowledge about the fungal community of an ecosystem is an important asset, as fungi are considered ecological indicators of perturbation within the environment (Hawksworth 1991; Hawksworth 1995; Guzman 1998). An inventory of fungal species present within The West Woods could predict the overall health of the park, as well as point out any regions to be monitored for overuse or stress, in the future.

Although often unobserved, fungi play a key role in ecological processes vital to ecosystem maintenance (Cibula 1974; Guzman 1998). Fungi are important decomposers of all sorts of complex organic molecules, including those materials high in cellulose, keratin, chitin, and lignins. Mycorrhizal fungi form symbiotic associations with the roots of 75-80% of vascular plants (Hawksworth 1991; Watling 1997), and are essential to the plant for the uptake of nutrients from the soil. Furthermore, fungi (in particular the mushroom-forming species) serve as valuable food sources for numerous invertebrate and vertebrate forest inhabitants (Hawksworth 1991; Watling 1997).

TABLE 1

*Taxonomy of Mycological Groups collected at  
The West Woods in Northeast (Geauga County) Ohio.*

Subdivision: Ascomycotina; Class: Ascomycetes

Family: Clavicipitaceae <i>Cordyceps</i> spp.	Family: Pezizaceae <i>Pachyella clypeata</i>
Family: Geoglossaceae <i>Geoglossum rufum</i>	Family: Pyrenomataceae <i>Scutellinia scutellata</i> <i>Scutellinia umborum</i>
Family: Helvellaceae <i>Discina perlata</i>	Family: Sarcosomataceae <i>Urnula craterium</i>
Family: Hypocreaceae <i>Hypomyces chrysospermus</i> <i>Hypomyces hyalinus</i> <i>Hypomyces luteovirens</i>	Family: Sclerotiniaceae <i>Ciboria peckiana</i>
Family: Leotiaceae <i>Bisporella citrina</i> <i>Leotia lubrica</i>	Family: Xylariaceae <i>Hypoxylon fragiforme</i> <i>Xylaria hypoxylon</i> <i>Xylaria polymorpha</i> <i>Daldinia concentrica</i> <i>Ustulina deusta</i>
Family: Morchellaceae <i>Morchella esculenta</i>	

Subdivision: Basidiomycotina; Class: Basidiomycetes

Family: Agaricaceae <i>Agaricus abruptibulbous</i> <i>Agaricus arvensis</i> <i>Agaricus campestris</i>	Family: Cantharellaceae <i>Cantharellus cibarius</i> <i>Cantharellus lateritius</i>
Family: Amanitaceae <i>Amanita brunnescens</i> <i>Amanita caesarea</i> <i>Amanita citrina</i> <i>Amanita cokeri</i> <i>Amanita muscaria</i> var. <i>formosa</i> <i>Amanita muscaria</i> var. <i>alba</i> * <i>Amanita pantherina</i> <i>Amanita rubescens</i> <i>Amanita vaginata</i> <i>Amanita virosa</i>	Family: Clavariaceae <i>Clavicornia pyxidata</i> (form. <i>Clavaria pyxidata</i> ) <i>Clavulinopsis fusiformis</i> (form. <i>Clavaria fusiformis</i> ) <i>Ramaria concolor</i> <i>Ramariopsis kunzei</i> <i>Sparassis crispa</i>
Family: Astreaceae <i>Astraeus hygrometricus</i>	Family: Coniophoraceae <i>Serpula lacrimans</i>
Family: Auriculariaceae <i>Auricularia auricula</i>	Family: Coprinaceae <i>Coprinus comatus</i> <i>Coprinus lagopus</i> <i>Coprinus micaceus</i> <i>Psathyrella candolleana</i> <i>Psathyrella delineata</i>
Family: Bolbitiaceae <i>Agrocybe praecox</i> <i>Bolbitius vitellinus</i>	Family: Corticiaceae <i>Christiansenia mycetophila</i> (form. <i>Tremella mycetophila</i> ) <i>Phlebia radicata</i>

TABLE 1 (Cont.)

*Taxonomy of Mycological Groups collected at  
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*Taxonomy of Mycological Groups collected at  
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Family: Boletaceae	Family: Cortinariaceae	<i>Russula emetica</i>	Family: Tricholomataceae
<i>Boletinellus merulioides</i>	<i>Cortinarius croceofolius</i>	<i>Russula silvicola</i>	<i>Armillaria mellea</i>
<i>Boletus bicolor</i>	<i>Cortinarius</i> spp.	<i>Russula variata</i>	(= <i>Armillariella mellea</i> )
<i>Boletus edulis</i>	<i>Galerina autumnalis</i>	<i>Russula</i> spp.	<i>Armillaria tabascens</i>
<i>Boletus hortonii</i> ~*	<i>Galerina tibicystis</i>		(= <i>Armillariella tabascens</i> )
<i>Boletus pulverulentus</i>	<i>Gymnopilus spectabilis</i>	Family: Schizophyllaceae	<i>Cheimonophyllum candidissimus</i>
<i>Boletus variipes</i>		<i>Schizophyllum commune</i>	(form. <i>Pleurotus candidissimus</i> )
<i>Boletus</i> spp.	Family: Crepidotaceae		<i>Clitocybe clavipes</i>
<i>Gyroporus castaneus</i>	<i>Crepidotus applanatus</i>	Family: Sclerodermataceae	<i>Clitocybe trullaeformis</i>
<i>Strobilomyces floccopus</i>	<i>Tuberia furfuracea</i>	<i>Scloderma citrinum</i>	<i>Collybia acervata</i>
<i>Tylopilus alboater</i>			<i>Collybia dryophila</i>
	Family: Polyporaceae	Family: Stereaceae	<i>Cryptotrama chryscephalum</i>
Family: Dacrymycetaceae	<i>Bjerkandera adusta</i>	<i>Stereum complicatum</i>	(form. <i>Collybia lacunosa</i> )
<i>Dacrymyces palmatus</i>	(= <i>Polyporus adusta</i> )	<i>Stereum ostrea</i>	<i>Laccaria lacata</i>
	<i>Bondarzewia berkeleyi</i>		<i>Laccaria ochropurpurea</i>
Family: Entolomataceae	(= <i>Polyporus berkeleyi</i> )	Family: Strophariaceae	<i>Lepista nuda</i>
<i>Entoloma abortivum</i>	<i>Cryptoporus volvatus</i>	<i>Naematoloma fasciculare</i>	(= <i>Clitocybe nuda</i> )
	(= <i>Polyporus volvatus</i> )	(= <i>Hypholoma fasciculare</i> )	<i>Marasmius delectans</i>
Family: Hydnaceae	<i>Daedalea quercina</i>	<i>Naematoloma capnoides</i>	<i>Marasmius rotula</i>
<i>Climacodon septrionalis</i>	<i>Daedaleopsis confragosa</i>	<i>Pholiota aurivella</i>	<i>Melanoleuca alboflavida</i>
(form. <i>Hydnum septrionale</i> )	<i>Favohus alveolaris</i>	<i>Pholiota squarrosoides</i>	<i>Mycena galericulata</i>
<i>Hericium coralloides</i>	<i>Fomes fomentarius</i>		<i>Mycena leaiana</i>
	<i>Fomes rimosus</i>		<i>Omphalotus olearius</i>
Family: Hygrophoraceae	(= <i>Phellinus rimosus</i> )		<i>Pleurotus dryinus</i>
<i>Hygrophorus coccineus</i>	<i>Fomitopsis pinicola</i>		<i>Pleurotus ostreatus</i>
<i>Hygrophorus flavescens</i>	<i>Ganoderma applanatum</i>		<i>Tricholomopsis platyphylla</i>
<i>Hygrophorus marginatus</i>	<i>Ganoderma tsugae</i>		<i>Xerophalina tenuipes</i>
<i>Hygrophorus russula</i>	<i>Grifola frondosa</i>		<i>Xerula furfuracea</i>
	<i>Inonotus</i> spp.		(= <i>Oudemansiella radicata</i> )
Family: Lycoperdaceae	<i>Laetiporus sulfureus</i>		
<i>Lycoperdon echinatum</i>	(form. <i>Polyporus sulfureus</i> )		
<i>Lycoperdon perlatum</i>	<i>Laetiporus cincinnatus</i>		
<i>Lycoperdon pyriforme</i>	(= <i>L. sulfureus</i> var. <i>semialbinus</i> )		
	<i>Piptoporus betulinus</i>		
Family: Nidulariaceae	(= <i>Polyporus betulinus</i> )		
<i>Crucibulum laeve</i>	<i>Polyporus alveolaris</i>		
<i>Cyatbus stercoreus</i>	<i>Polyporus arcularius</i>		
<i>Cyatbus striatus</i>	<i>Polyporus brumalis</i>		
	<i>Polyporus elegans</i>		
Family: Paxillaceae	(= <i>Polyporus varius</i> )		
<i>Paxillus atrotomentosus</i>	<i>Polyporus melanopus</i>		
	<i>Polyporus radicans</i> *		
Family: Phallaceae	<i>Polyporus squamosus</i>		
<i>Mutinus elegans</i>	<i>Poronidulus conchifer</i>		
	(= <i>Polyporus conchifer</i> )		
Family: Pluteaceae	<i>Pycnoporus cinnabarinus</i>		
<i>Pluteus cervinus</i>	(= <i>Polyporus cinnabarinus</i> )		
	<i>Trichaptum bififormis</i>		
Family: Russulaceae	<i>Trametes versicolor</i>		
<i>Lactarius delictosus</i>	<i>Tyromyces chioneus</i>		
<i>Lactarius vinaceorufescens</i>	<i>Tyromyces fissilis</i>		
<i>Russula aeruginea</i>	<i>Tyromyces fragilis</i>		
<i>Russula brevipes</i>			

\*Of special note are those species described as rarely occurring in North America (see Lincoff 1984; Arora 1986; Phillips 1991).

Previous studies of fungal diversity found in northern Ohio are rare (Cibula 1974). Most previous work has centered on the Ascomycetes (Fink 1915; Fink and Richards 1915) with particular attention to two genera (Corrington 1921). Surveys of Basidiomycetes are more scarce and mainly have been focused on the interactions between the fungus and other organisms (Bunyard and Foote 1990). The most thorough survey of Basidiomycete fungi previously recorded (Cibula 1974) was carried out in Geauga and Cuyahoga counties, and noted only 32 species from the region. This current study found at least 134 species from 30 families of Basidiomycetous fungi (and at least 19 species from 11 families of Ascomycetous fungi). There were species described in one, but not both studies. Furthermore, it was also surprising to note the absence (from both studies) of many species of higher fungi known to commonly occur in the midwestern USA. Reasons for not finding such common species are as varied as the mushrooms themselves and can include weather, soil pH, other fungal and

non-fungal species, and microclimatic phenomena (Cibula 1974), as well as poor collecting. Nonetheless, this paucity of information points out the need for further such surveys before additional habitat is lost.

Of special note in Table 1 are those species described as being rarely found in North America (see Lincoff 1984; Arora 1986; Phillips 1991). Those mushrooms known rarely to occur in North America, but documented from The West Woods herein, include *Amanita muscaria* variety *alba* and *Boletus hortonii*; although not considered rare, *Pleurotus dryinus* and *Polyporus radicans* are not commonly found.

Collectively, these data point out the importance of The West Woods ecosystem to biodiversity of fungi in particular, and possibly to overall biodiversity in general, and as an invaluable preserve for the northeast Ohio region.

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